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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/688,021	10/13/2000	Rao Annapragada	LAM1P154	7485

22434 7590 03/10/2004

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EXAMINER	
ANDERSON, MATTHEW A	

ART UNIT	PAPER NUMBER
1765	

DATE MAILED: 03/10/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/688,021	ANNAPRAGADA ET AL.	
	Examiner	Art Unit	
	Matthew A. Anderson	1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *23 December 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,4-7,10-18,20 and 21* is/are pending in the application.

4a) Of the above claim(s) *15-18* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,4-7,10-14,20 and 21* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *13 October 2000* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 12/23/2003 has been entered.

Claim Rejections - 35 USC § 112

2. Claims 1,4-7, 10-14, 20-21 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

In respect to the claims 1 and 7, there is no indication in the specification that the layer of organosilicate glass dielectric is over an etch stop layer of any sort.

Claims dependent on independent claims 1 and 7 are similarly not supported.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1-7, 10-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hung (US 6,387,287 B1) as applied to claims 1-5, 7-10 above, and further in view of Chiang et al. (US 5,739,579) and Wolf et al. (Volume 1, pp. 556).

Hung et al. discloses in col. 16 lines 1-43 and in Table 10 a method of etching with plasma an organic silicate glass (i.e. the TEOS ARC layer) on a wafer with a gas comprising C_4F_8 and CF_4 and argon (Ar). In col. 17 lines 20-35, Hung further suggests the improvement of nitride corner selectivity by the inclusion of a more polymerizing gas such as CH_2F_2. The problems of reduced etch stop often associated with increased polymerization can be counteracted by the use of N_2 or O_2. Hung et al. discloses an SiN etch using CH_2F_2, O_2 and Ar in Fig. 11. The need for gas chemistry control points one of ordinary skill to the inherent placement of a wafer in a reaction chamber for performance of this process.

Hung et al. does not explicitly disclose the use of CH_2F_4 (aka tetra-fluoromethane) and O_2 as components of the organic oxide etchant gas containing C_4F_8, CF_4, and Ar.

Hung does not explicitly suggest the etching through the underlying etchstop layer or of what material such a layer be composed.

Chiang et al. discloses a method for forming interconnections in devices of multiple levels. Chiang et al. discloses etch stop materials of Si_3N_4 (silicon nitride and SiC (silicon carbide) and others in col. 14 lines 65+ and in col. 15 lines 1-3 beneath oxide layers of (see col. 15 lines 25-33) spin on glass (i.e. TEOS), PSG, and BPSG.

Wolf et al. discloses the patterning by etching of Si_3N_4 layers with plasma etching of CF_4 and O_2 on page 556.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to combine Hung with Chiang et al. and Wolf et al. because Chiang adds known materials for etch stop layers and Wolf et al. discloses how to pattern (i.e. etch them). Motivation for the combination is found in that Chiang et al. lists known materials which function as etch stops under organic silicates and Wolf et al. discloses the known use of specific gas chemistry to etch them. Chiang also add to the utility of etching the organic silicates since multilevel interconnections are suggested therein.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to modify the Hung et al. reference Hung et al. suggests the addition of CH2F2 and O2 to plasma etching gases for greater nitride selectivity and thus more precision in the manufacture of electronic devices. This suggests etching selectively.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to combine the usual C_4F_8, CF_4, Ar, CH_2F_2, and O_2 in a plasma etchant gas used on organo-silicate glass (by its nature a dielectric) which was over an

etch stop layer because such is suggested by the description of Hung et al. and Chiang et al. combined and such a combination of gases would have been expected to perform the function of organic glass etching with great selectivity to any underlying nitride etch stop layers.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to use a Si_3N_4 etchstop layer and to etch it with CH_4, O_2, and Ar because Chiang et al. discloses etch stop materials and Wolf et al. discloses means of etching Si3N4. The use of Argon as a diluent in etching gases was suggested by Hung et al. as above.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to use a Si_3N_4 etchstop layer and to etch it with CH_2F_2, O_2, and Ar because Chiang et al. discloses alternate etch stop materials and Hung et al. discloses this means of etching Si_3N_4.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to stop one gas flow (C_4F_8) and (CF_4) and switch to another gas flow (CH_2F_2 O_2 and Ar) because the CH_2F_2 ,O_2 and Ar mixture was specifically known in the art as a preferred etchant gas for Si_3N_4

It would have been obvious to one of ordinary skill in the art at the time of the present invention to use a consistent gas formulation when again etching oxide because use of the same gas plasma formulation suggested above would have been expected to assure consistent results.

5. Claims 14, 20, 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hung et al. Chiang, and Wolf et al. as applied to claims 1-13 above in view of Li et al. (US 6,284,149 B1).

Hung combined is described above.

The combination does not suggest the stripping a photoresist with the specified etch chemistry.

Li et al. discloses a low dielectric oxide (divinyl siloxane-benocyclobutene). This material is described as a mostly polymer with a small amount of oxide included and is disclosed as an alternative to BPSG. A method of etching in Table 6 second step is shown to include O_2, CH_2F_2, N_2. The second step is described as for the removal of photoresist and excess low dielectric oxide. In column 19 lines 31-42 it is disclosed that the etchant gases can include Ar if the amount thereof is minimized.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to combine Hung combined with Li et al. because Li adds known photoresist removal methods to the nitride selective organic oxide etching suggested above. Motivation for the combination is found in that Li et al. uses the same gases as suggested in Hung combined thus reducing the need for other etchant gas chemistry and in turn reducing material costs.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to stop one gas flow and switch to another gas flow because a mixture of CH_2F_2, O_2, Ar, and N_2 was specifically known in the art as a preferred etchant gas for photoresist and Hung combined above suggests another gas chemistry for organic

oxides with nitride etch stop layers. The use of the optimal gas chemistry for the specific gas layer to be etched would have been obvious to the typical process engineer of ordinary skill. Such optimization would have been achieved with only routine experimentation.

Response to Arguments

6. Applicant's arguments filed 12/23/2003 have been fully considered but they are not persuasive.

In response to applicant's argument that Hung et al does not suggest organo-silicate glass to nitride selectivity, the fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985). Organo-silicate glass is an oxide and such selectivity would have been expected as suggested by Hung et al. Similarly, sufficient motivation exists to modify the etchants used to etch oxide glass. BSPG and OSG are at least suggested to be equivalent alternatives by Chiang (see col. 15 lines 25-33).

The argument of the first paragraph of page 8 is not convincing. Etching selectively in itself suggests that there is a relative difference of etching between two materials (i.e. different layers –oxide versus etch stop).

The argument that nitride is different from OSG is not contested by the examiner. However, the listed gases were also known to etch OSG and be useful in chemistries for that purpose.

The argument that there is no suggestion to use different gas chemistries to etch silicate glasses is countered by Hung in col. 17 line 45-55 where other hydrogen free fluorocarbon gases or hydro-fluoro-carbon gases be used in the etching mindful of the results in selectivity ad polymerization.

The argument against Li et al. combined is not persuasive. Li teaches a useful composition for stripping resist. The splitting of one step into two, where the processes are substantially identical in terms of function, manner, and result was held to not patentably distinguish the process. In this case, Li has a simultaneous etch/strip. Splitting this up would still have the same manner, function, and result which is etching and stripping.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew A. Anderson whose telephone number is (571) 272-1459. The examiner can normally be reached on M-Th, 7-5:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

MAA
February 26, 2004

NADINE G. NORTON
SUPERVISORY PATENT EXAMINER